

FDH Engineering, Inc.

National Certification Programs for the Innovative Inspection of Aging Infrastructure

Madame Chairwoman, Senator Shelby and distinguished members of the Committee,

Thank you for allowing me the opportunity to provide this written testimony on behalf of FDH Engineering, Inc. so that we can share our experience in developing innovative non-destructive testing (NDT) and non-destructive evaluation (NDE) technologies for the inspection of aging infrastructure and the need to establish centralized funding streams within the agencies to allow for the demonstration, validation and certification of emerging, innovative technologies.

FDH Engineering was founded in 1994 by two professors and a doctoral graduate at North Carolina State University and has since grown to over 260 employees with offices currently located in North Carolina, Missouri, Louisiana, California, Ohio and Arizona. Our employees consist primarily of engineers and highly skilled technicians. Our engineers are licensed in all 50 states, DC, Puerto Rico, the US Virgin Islands and the Northern Mariana Islands.

While FDH Engineering has developed numerous technologies and methodologies for the inspection of aging infrastructure primarily through internal funding, federal funding – whether provided indirectly through flow down funding to state and local authorities or directly through partnerships with universities and federal labs such as the USACE Engineering Research and Development Center (ERDC) in Vicksburg, MS or the Corps' engineering districts – has been critical for the demonstration and validation of the accuracy, time, cost and safety considerations for these methodologies.

Why our focus on the inspection of aging infrastructure? It is well known that the nation's infrastructure – highways, bridges, dams, levees, ports, pipelines, etc. – were mostly built in the mid-20th century and some 50 years later we are facing the twin problems of maintaining and modernizing that infrastructure in order to support our communities, our economic growth, our security and the many other activities that keep our nation strong and vibrant.

During his 2011 State of the Union address, President Obama noted “Our infrastructure used to be the best, but our lead has slipped...., when our own engineers graded our nation's infrastructure, they gave us a “D”.

In their most recent *2013 Report Card for America's Infrastructure*, the American Society of Civil Engineers (ASCE) raised that grade – to a “D+” – noting this demonstrates that we can improve the current condition of our nation's infrastructure when investments are made and projects move forward. The grades for specific infrastructure sector ranged from a high of “B-” for solid waste to a low of “D-” for inland waterways and levees.

In this period of constrained spending, FDH uses innovation and technology to do more with less to improve and better manage critical infrastructure. Consistent with our experience, I would like to describe a few cases where FDH partnered with states and the federal government to find innovative solutions to improve the speed, safety and accuracy of inspection activities associated with three of the infrastructure categories addressed by ASCE: bridges, dams and levees. These efforts are leading to immediate cost savings and infrastructure improvements.

Moving first to bridges which received a “C+” from ASCE (up from a “C” in 2009), FDH Engineering was founded on the ability to map unknown foundations and to perform scour analysis of bridge pilings using NDT/NDE inspection techniques and technologies developed by the founders. The use of dispersive pulse echo testing and dispersive bending wave testing allowed for quicker, less expensive, more accurate, and safer inspections of these pilings by obviating the need for heavy drilling and excavation equipment, the use of divers in murky fast moving currents, or the interruption of traffic flow patterns across the bridge during the inspection period. The FDH-developed bending wave analysis technique provides a 50-80% cost savings over traditional pile testing methods. FDH Engineering began demonstrating and validating their techniques by working with the North Carolina Department of Transportation, performing inspections side-by-side with traditional methods until such time as NCDOT was satisfied that the techniques were valid and accurate.

Since that time, FDH Engineering has worked with DOT offices in a number of other states such as South Carolina, Louisiana, Oregon, Colorado, Alabama, and Mississippi as well as on military facilities such as Elmendorf AFB, Hickam AFB, Scott AFB, McConnell AFB, and McGuire AFB to complete the inspection of thousands of bridges. For example, in 2001 the Louisiana DOTD had 6000 bridges listed with unknown foundations but through the use of FDH’s NDT/NDE inspection techniques, that number is now less than 3000 and the last contract for the inspection of 900 bridges was completed a year ahead of schedule.

It is important to note that this work was accomplished by working with the various state DOTs using their operation and maintenance funds and it was only through consistent and proven results that those agencies came to accept the validity and cost-effectiveness of the methodologies.

Turning to the dams that provide flood protection, drinking water, irrigation and electricity to millions of Americans, ACSE rated them with a “D”, the same score as in 2009. Of the 84,000 dams in America, almost 14,000 of them are rated high-hazard and of those dams 2,000 are rated as deficient.

FDH Engineering has been working with the Corps of Engineers since 2008 to develop and demonstrate an NDT method to quickly and safely measure the tension in the rods that secure a dam’s tainter gates through which the water flows. If a sufficient number of these rods lose their tension or “fail,” the tainter gate must be permanently closed thus affecting the effectiveness of the dam to control flooding and navigation. Currently, inspection of trunnion anchor rods has been prohibitively difficult and costly leaving the Corps with an escalating, unquantifiable risk for dam safety and operations. The current method of determining the integrity of a rod – a type of mechanical proof test that pulls on the rod – requires removal of the anchorage cover box, scaffolding to access the anchor rods, and the use of a hydraulic jack system. Once safe access has been established, the rate of testing with this method is 5-10 rods per day. In addition, human safety is a significant concern, as even a modest over-tensioning of the anchor rod in this test may result in rod failure.

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By contrast, the innovative method developed by FDH and their partners at the USACE Engineering Research and Development Center in Vicksburg, MS has been demonstrated at four different Corps-operated dams and has been shown to be as accurate as the previous method but ten times quicker and ten times cheaper per rod with very little to no risk to personnel.

At this time, FDH is working with the Corps to perform the engineering validation of this methodology so the older, more costly lift-off method will no longer be required and the new test method can be adopted for all Corps dams. The envisioned \$3-4 million validation program would test all the trunnion rods in 4-8 unique dams over a period of twelve to eighteen months. However, funding for this effort has become problematic as the engineering districts which oversee the dams to be inspected must identify demonstration funding from within available O&M funds which, for the most part, have already been budgeted for other work.

In comparison, repairs to infrastructure after failure are quite costly. We note that the FY2015 President's Civil Works budget justification contains requests totaling over \$30 million for the repair of failed tainter gates and associated trunnion bearing components at just two Corps-operated dams. A national certification program for the innovative technologies that may have identified such problems before failure would cost just 10% of that figure and would be applicable across the entire dam inventory.

Finally, the *2013 ASCE Report Card* assigned its lowest grade of "D-" to the nation's levee infrastructure – a not unexpected result given the warning provided in the National Committee on Levee Safety's 2009 Report to Congress that "The current levee safety reality for the United States is stark—uncertainty in location, performance and condition of levees and a lack of oversight, technical standards, and effective communication of risks. . . . The Committee's recommendations are prefaced by recognition of a need for a broader national flood risk management approach . . . and call for leveraging levee safety as a critical first step in a national infrastructure investment"

Clearly, one of the critical first steps in any levee safety program must be detailed and accurate inspections of the levees, however, current levee inspection techniques are too expensive and time-consuming to keep pace with the demand for the inspections necessary to manage risk and prioritize repairs.

Make no mistake; the extent of the inspection backlog is considerable. The Federal Emergency Management Agency (FEMA)'s Midterm Levee Inventory estimates that as many as 100,000 miles or more of levees exist in the US. Of the 14,700 miles of levees operated by the Corps of Engineers, only 8% are found to be in acceptable condition, with 69% minimally acceptable, and 22% unacceptable. Similar statistics are unavailable for the approximately 85,000 miles of levees owned and operated by state and local governments/authorities, although it is reasonable to assume that they are comparable to USACE-operated levees.

Working with USACE Headquarters and the Southeast Louisiana Flood Protection Authority–West, FDH is seeking to demonstrate and validate a new innovative and low cost approach to levee inspection. FDH has developed a high-area-rate, extended mission duration, non-destructive levee inspection capability by integrating emerging infrared energy pattern analysis

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technology with proven LIDAR technology on aerial platforms in order to perform federal, state and local authority mandated levee inspections. Demonstrations in different locations in the US such as Louisiana, California, Missouri, and Iowa are recommended in order assess performance against variables such as levee construction techniques (concrete, earthen, etc.) and usage (flood protection, navigable waterways, agricultural, etc.). FDH anticipates that a demonstration and validation program consisting of an initial baseline inspection and up to three follow-on inspections after significant events will cost approximately \$6.0 million and can be completed in eighteen to twenty-four months (depending on the frequency of follow-on events) for each region.

However, because this effort is a combination of operations and maintenance and R&D and will occur across a combination of federal, state and local jurisdictions, it is unlikely any one federal, state or local authority would be willing or able to fund a program that would include work outside of their respective jurisdictions.

In conclusion, as I noted at the beginning of my testimony, the innovative technologies FDH Engineering develops are primarily funded through our own internal R&D budget. However, federal funding through our contracts with federal agencies or provided through state funding has been a key component for the successful demonstration, validation and eventual adoption of our NDT/NDE approaches to the inspection of aging technology.

But it has become clear to us that the piecemeal approach of seeking out federal, state and local sponsors to fund specific validation projects is inefficient and unnecessarily delays the certification and adoption of the technologies and methods that offer significant time and cost savings for the federal sector. Furthermore, from our discussions with agencies responsible for this infrastructure such as the Corps of Engineers, FERC, Bureau of Reclamation, TVA and the FHWA, it is clear that a national certification program would be helpful in ensuring these innovations are adopted uniformly across federal agencies in a more expedient and efficient manner.

For FY2014, Congress included language in the EWD appropriations report urging the Corps to prioritize the validation of proven, high-payoff innovative practices and technologies at the national level. We respectfully request that Congress continue its efforts to establish sustainable funding streams at the national level for the demonstration, validation and certification of emerging and innovative technologies.

I thank the Committee for its time and the opportunity to submit this testimony.

Outside Witness Testimony respectfully submitted by:

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